

A New Cottoid Fish of the Family Ereuniidae, *Marukawichthys pacificus*, from the Central North Pacific

Mamoru Yabe

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Abstract *Marukawichthys pacificus* captured from the Emperor Seamount Chain in the central North Pacific is described as a new species in the family Ereuniidae. It is the second species of the genus *Marukawichthys* and closely related to *M. ambulator* Sakamoto, from which it differs in having a narrower interorbital space, longer upper jaw, chin with smooth skin, greater number of gill rakers and vertebrae, and uniformly dark brown body color. This species is the first cottoid to be recorded from the Emperor Seamount Chain.

Seven specimens of an undescribed cottoid fish were trawled on the Emperor Seamount Chain in the central North Pacific by the Hokusei-Mar, the training ship of the Hokkaido University, in 1977. The present species is closely related to *Marukawichthys ambulator* Sakamoto, 1931, which is known only from deep waters around Japan. Both species have four free pectoral rays and one spine and four soft rays in the pelvic fin, but the new species differs from the latter in meristic counts, proportional measurements and body color. In this paper the external and osteological features of the new species, *Marukawichthys pacificus*, are described.

The specimens examined here are deposited in the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, Hakodate (HUMZ), the Department of Zoology, National Science Museum, Tokyo (NSMT-P), the Department of Fisheries, Faculty of Agriculture, Kyoto University, Kyoto (FAKU), and the California Academy of Sciences, San Francisco (CAS). Measurements follow the recommendations of Hubbs and Lagler (1958) except that depth of body was measured between the origin of the first dorsal spine and the origin of the pelvic fin. Counts of lateral line scales were made from the first scale to the end of the hypural plate. All fin ray elements were counted. The caudal fin and vertebrae were counted from radiographs. The caudal vertebrae were counted starting with the first vertebra having a haemal spine and ending with the urostylar vertebra. Osteological characters were examined

in a specimen stained with Alizarin red-S then dissected and observed with a binocular microscope. The bone drawings were made with the aid of a Wild M-8 drawing tube. The osteological nomenclature used here chiefly follows that of Uyeno (1975).

Marukawichthys pacificus sp. nov.

New Japanese name: Tengu-kajika

(Figs. 1~5)

Holotype. HUMZ 68657, a male, 226.7 mm standard length (SL), 35°29.3'N, 171°42.0'E, depth 570 m (Emperor Seamount Chain, central North Pacific), on July 29, 1977.

Paratypes. HUMZ 68659, a female (273.0 mm SL); HUMZ 68660, a female (234.3 mm SL, skeleton); HUMZ 68661 and 68662, a male and a female (219.5~229.4 mm SL); NSMT-P 21425, a female (274.7 mm SL); CAS 51359, a male (232.9 mm SL). All paratypes were collected with the holotype.

Comparative materials. *Marukawichthys ambulator*: FAKU 1394, 1397 and 1399, 3 specimens, off Owase, Mie Pref., Japan, in Dec., 1935; FAKU 1665~1667, 3 specimens, off Owase, in Jan., 1937; FAKU 10568, 1 specimen, off Maizuru, Kyoto Pref., Japan, on Dec. 19, 1948; FAKU 17158, 1 specimen, off Miya, Aichi Pref., Japan, on Jan. 8, 1951; FAKU 17682~17684, 3 specimens, off Miya, on Mar. 15, 1952; FAKU 20586, 1 specimen, off Miya, on Apr. 10, 1953; HUMZ 5197, 1 specimen, off Same, Aomori Pref., Japan, date unknown; HUMZ 5200, 1 specimen, off Miyako, Iwate Pref., Japan, date unknown; HUMZ 57098, 1 specimen, off Onahama, Fukushima Pref., on Sep. 16, 1976; HUMZ 77520~77523, 4 specimens, off Shiranuka, Aomori Pref., on Sep. 26, 1978; HUMZ 87083, 1 specimen, off Oma, Aomori Pref., on Dec. 15, 1979;

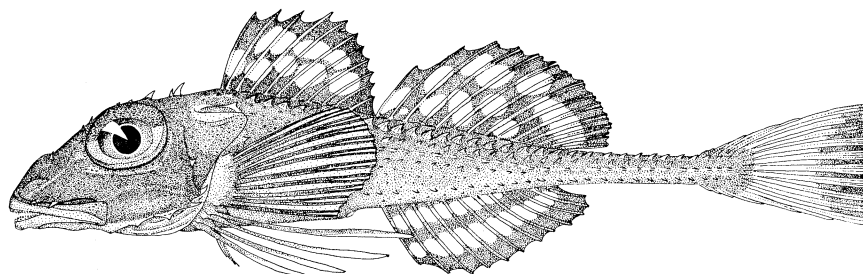


Fig. 1. *Marukawichthys pacificus* sp. nov., holotype, HUMZ 68657, male, 226.7 mm SL.

HUMZ 90648~90652, 5 specimens, Miyako fish market, Iwate Pref., on Apr. 23, 1981.

Diagnosis. A member of the genus *Marukawichthys* with the following characters: narrow interorbital space, width 19.6~21.2 in head length (HL); long upper jaw, length 2.3~2.5 in HL; gill rakers on the first arch $3+12\sim13=15\sim16$; vertebrae $13+25\sim26=38\sim39$; chin covered with smooth skin (Fig. 2); body and pectoral fin uniformly dark brown without cross bands (Fig. 1).

Description. First dorsal rays XI (X~XI in paratypes); second dorsal rays 14 (14~16); anal rays 12 (12~14); pectoral rays 15 (15); pelvic rays I, 4 (I, 4); gill rakers on first arch $3+12$ ($3+12\sim13$); vertebrae $13+25$ ($13+25\sim26$) (see Table 1). Proportional measurements of the holotype and paratypes are shown in Table 2.

Body moderately elongate, compressed anteriorly, tapering into a long slender, quadrate caudal peduncle. Head large and slightly compressed. Snout long, its length 1.3 (1.2~1.4) times orbit diameter. Eye very large, its upper margin projecting above outline of head. Orbit diameter 1.1 (1.0~1.1) in postorbital head length. Interorbital space very narrow and slightly con-

cave, its width 6.2 (5.7~6.9) in orbit diameter. Mouth horizontal, lower jaw included (Fig. 2A). Maxillary reaching to just below the anterior margin of pupil. Depth of maxillary end 2.1 (2.1~2.5) times interorbital width. Anteriormost pore of mandibular series opening on either side of symphysis (Fig. 2A). Villiform teeth on jaws, vomer and palatines. Branchiostegal membranes broadly united, free from isthmus. Gill rakers short and club-shaped. A slit present behind last gill arch.

Head and body rough, covered with minute prickles. Upper margin of eye-ball, maxillary and lower jaw covered with prickles. Chin, gill membranes, pectoral axilla and bases of dorsal, anal and pectoral fins smooth without prickles. Nasal spine small but sharp. Two strong spines present along lower margin of the lachrymal, anterior one directed forward and posterior one downward. Five preopercular spines present; upper spine small, existing on same level as lower margin of orbit; the second largest, directed slightly upward; the third somewhat smaller than the second, directed backward; the fourth and the fifth small, directed downward. Opercular spine small but sharp.

Table 1. Frequency distributions of six meristic characters of *Marukawichthys pacificus* sp. nov. and *Marukawichthys ambulator*.

Species	First dorsal fin			Second dorsal fin				Anal fin				Vertebrae				
	IX	X	XI	13	14	15	16	11	12	13	14	35	36	37	38	39
<i>M. pacificus</i>		2	5*		3*	3	1		2*	5					3*	4
<i>M. ambulator</i>	1	11	14	14	11	1		1	20	4	1	3	7	16		
	Lateral line scales								Gill rakers on first gill arch							
	30	31	32	33	34	35	36	37	10	11	12	13	14	15	16	
<i>M. pacificus</i>						1	5*	1						5*	2	
<i>M. ambulator</i>	4	2	2	5	6	3	2		1	10	9					

* Holotype included.

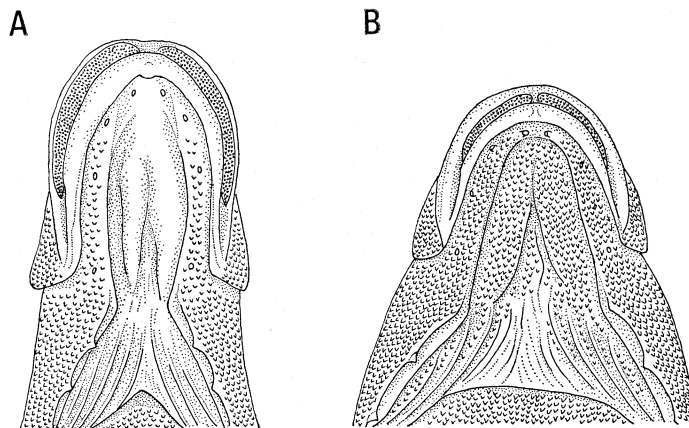


Fig. 2. Ventral view of head. A, *Marukawichthys pacificus* sp. nov. (holotype). B, *Marukawichthys ambulator* (HUMZ 77522). Scale bars indicate 10 mm.

Three spines present along anterior margin of orbit, but not fused with cranium. A large spine present on posterodorsal margin of orbit, united with frontal bone. A strong forked spine present on parietal region, united with the parietal bone. Posterodorsal margin of the

cleithrum with a small but sharp spine. Posterior end of the supracleithrum not sharp. Six rows of spiny scales present on body. Dorsal row composed of 36 (35~38) spiny scales, originating immediately in front of first dorsal fin and ending at caudal base. Posterior part of this

Table 2. Proportional measurements of *Marukawichthys pacificus* sp. nov. and of *Marukawichthys ambulator*.

Character	<i>Marukawichthys pacificus</i>		<i>M. ambulator</i>	
	Holotype	Paratypes	Original description (Sakamoto, 1931)	Comparative materials (26 specimens)
Standard length (mm)	226.7	229.4~274.7	190	82.2~181.8
Proportional measurements in SL				
Body depth	5.7	5.5~6.1	3.9	4.6~5.7
Head length	2.8	2.7~2.8	2.6	2.7~3.1
Predorsal length	3.1	2.9~3.1		3.0~3.7
Preanal length	2.0	1.8~1.9		1.9~2.0
Length of 1st dorsal base	4.8	4.3~5.1		4.1~5.1
Length of 2nd dorsal base	3.5	3.4~4.2		3.1~3.9
Length of anal base	4.2	3.8~4.6		3.6~4.7
Caudal peduncle length	4.2	4.1~4.9		3.5~4.5
Proportional measurements in HL				
Head depth	2.2	2.1~2.2		1.7~1.9
Head width	2.8	2.2~2.7		1.6~2.1
Snout length	2.6	2.4~2.6	2.5	2.5~2.9
Orbital diameter	3.2	2.9~3.4	3.1	2.6~3.2
Postorbital head length	3.0	2.9~3.1		2.7~2.9
Upper jaw length	2.4	2.3~2.5	2.9	2.7~3.0
Caudal peduncle depth	13.4	12.8~14.4		9.4~12.7
Interorbital width	19.8	19.6~21.2		9.0~16.0
Pelvic fin length	4.0	4.0~4.6		3.1~4.2

row forming dorsolateral corner of caudal peduncle. Supralateral row composed of 31 (29~35) scales and extending from posterior end of opercular flap to caudal peduncle, but their spines weaker than those of dorsal row. Scales on lateral line 36 (35~37), bearing small but sharp spines and forming lateral row of spines. Infralateral row composed of 20 (17~19) spiny scales and extending from posterior end of opercular flap to under middle part of second dorsal fin. Supraventral row composed of 28 (27~30) scales; their spines not so developed anteriorly but well developed posteriorly and forming ventrolateral corner of caudal peduncle. Ventral scale row rudimentary; 12 (11~15) minute spines situated on the anal fin base; before anal fin origin, the scales of this row gradually assimilated with many scales on belly.

First dorsal fin originating slightly posterior to upper end of gill opening. Second dorsal fin separated from first dorsal fin by short distance. Length of second dorsal base 1.3 (1.2~1.4) times that of first dorsal base. Anal fin originating under between second and third rays of second dorsal fin, and ending slightly behind posterior end of second dorsal fin. Pectoral fin separated into two parts; upper 11 rays usually branched and united by fin membranes; lower four rays unbranched and separated from each other. Upper rays of lower lobe longest and extending posteriorly to base of third anal ray. Pelvic fin short, its length 1.3 (1.3~1.5) in orbit diameter. Caudal fin truncated, 12 (12) rays situated on posterior margin of the hypural, inner 10 (8~10) rays branched. Nine (9~11) upper procurent caudal rays and 9 (8~10) lower ones present.

Color of fresh specimen. Head and body uniformly dark brown, suborbital region and pectoral axilla darker. Dorsal and anal fins black with two series of white blotches. Caudal fin translucent with black distal margin. Upper lobe of pectoral fin rays black with translucent membranes. Lower four rays of pectoral fin dark brown proximally, and white distally. Peritoneum black.

Osteology. The osteological characters of the present species are essentially the same as that in *Marukawichthys ambulator* described by Yabe (1981). The main features are described below.

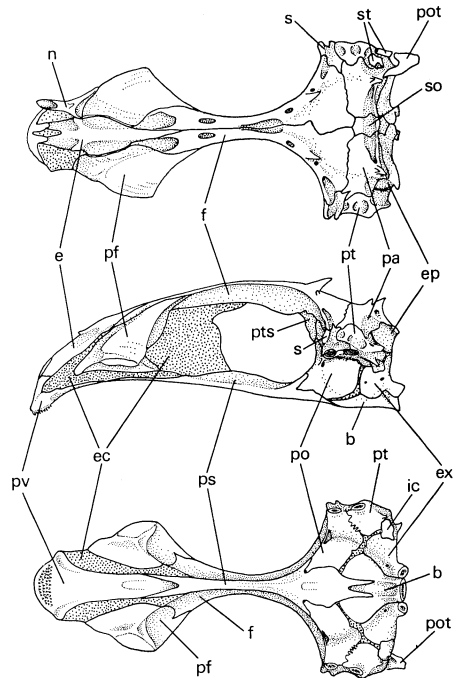


Fig. 3. Dorsal (above), lateral (middle) and ventral (below) aspects of the cranium in *Marukawichthys pacificus* sp. nov., paratype (HUMZ 68660). b, basioccipital; e, ethmoid; ec, ethmoid cartilage; ep, epiotic; ex, exoccipital; f, frontal; ic, intercalar; n, nasal; pa, parietal; pf, prefrontal; po, prootic; pot, posttemporal; ps, parasphenoid; pt, pterotic; pts, pterosphenoid; pv, prevomer; s, sphenotic; so, supraoccipital; st, supratemporal. Scale bar indicates 10 mm.

Cranium and temporal bones (Fig. 3): The cranium is characterized by having large rostral and orbital regions and small occipital region. The ethmoid cartilage (ec) is well developed. Posterior part of the ethmoid cartilage forms a median septum in the anterior part of orbit. The basisphenoid is absent. The frontal (f) has a strong spine posterodorsally. The prootic (po), which possesses a thin vertical bridge crossing over the trigemino-facialis chamber, interposes between the pterosphenoid (pts) and parasphenoid (ps) and helps to form the posterior margin of orbit. A transverse groove for the sensory canal is present on the posterodorsal part of the occipital region. The supraoccipital (so) is situated between both parietals (pa).

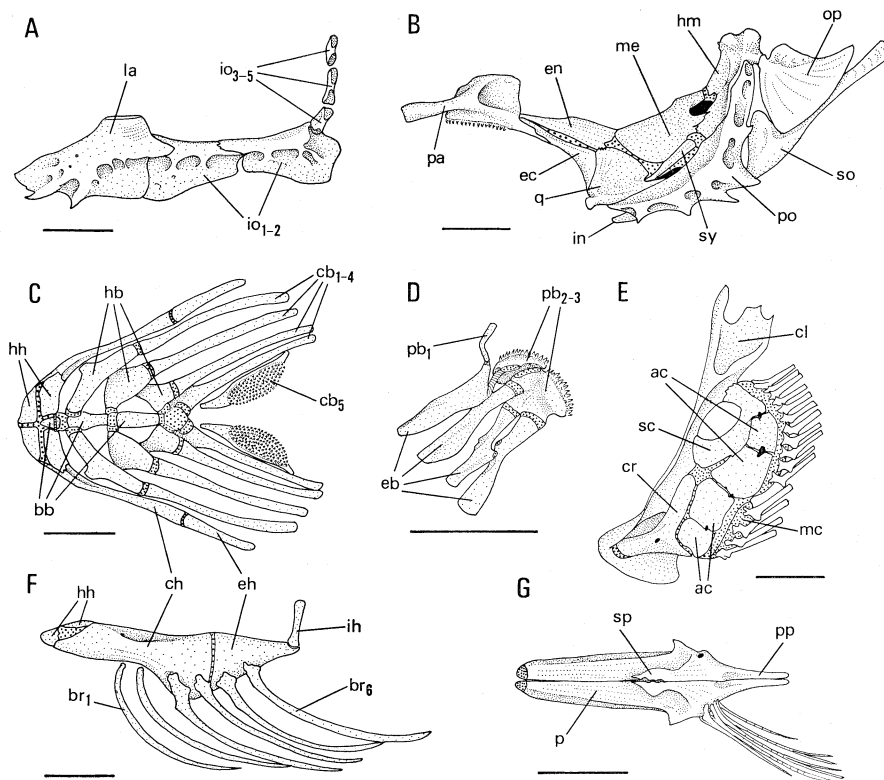


Fig. 4. Skeletal parts of *Marukawichthys pacificus* sp. nov., paratype (HUMZ 68660). A, lateral aspect of circumorbital bones. B, lateral aspect of suspensory apparatus. C, oral surface of branchial and hyoid apparatus (interhyal, epibranchials and pharyngobranchials are removed). D, dorsal view of epibranchials and pharyngobranchials. E, lateral aspect of pectoral girdle (temporal bones, supracleithrum are removed). F, lateral aspect of hyoid arch. G, ventral aspect of pelvic girdle. ac, actinost; bb, basibranchial; br, branchiostegal; cb, ceratobranchial; ch, ceratohyal; cl, cleithrum; cr, coracoid; eb, epibranchial; ec, ectopterygoid; eh, epihyal; en, endopterygoid; hb, hypobranchial; hh, hypohyal; hm, hyomandibular; ih, interhyal; in, interopercle; io, infraorbital; la, lachrymal; mc, movable cartilage; me, metapterygoid; op, opercle; p, pelvis; pa, palatine; pb, pharyngobranchial; po, preopercle; pp, postpelvic process; q, quadrate; sc, scapula; so, subopercle; sp, subpelvic process; sy, symplectic. Scale bars indicate 10 mm.

The intercalar (ic) is a small bone which is situated between the pterotic (pt) and exoccipital (ex). The vagus foramen opens on the exoccipital. The Baudelot's ligament attaches to the basioccipital (b). The two supratemporals (st) are small tubular bones situated above the dorsal face of the pterotic. The posttemporal (pot) has two processes; the anterodorsal process articulates with dorsal face of the epiotic (ep), and the anteroventral process is ligamentously connected with the intercalar.

Circumorbital bones (Fig. 4, A): The lachrymal (la) possesses two spines anteroventrally. Five infraorbitals (io) are present; the anterior

two are plate-like bones with the second forming the suborbital stay, while the posterior three are small tubular bones.

Suspensory apparatus (Fig. 4B): The hyomandibular (hm) has a low ridge, where the tendon of the adductor mandibularis inserts, adjacent to the anterior margin of the preopercle. There is a large gap between the hyomandibular and the metapterygoid (me). The palatine (pa) articulates with the maxillary at the anterior process and with the lachrymal dorsolaterally; it is connected with the prefrontal and the ascending process of premaxillary by strong ligaments. The oral surface of

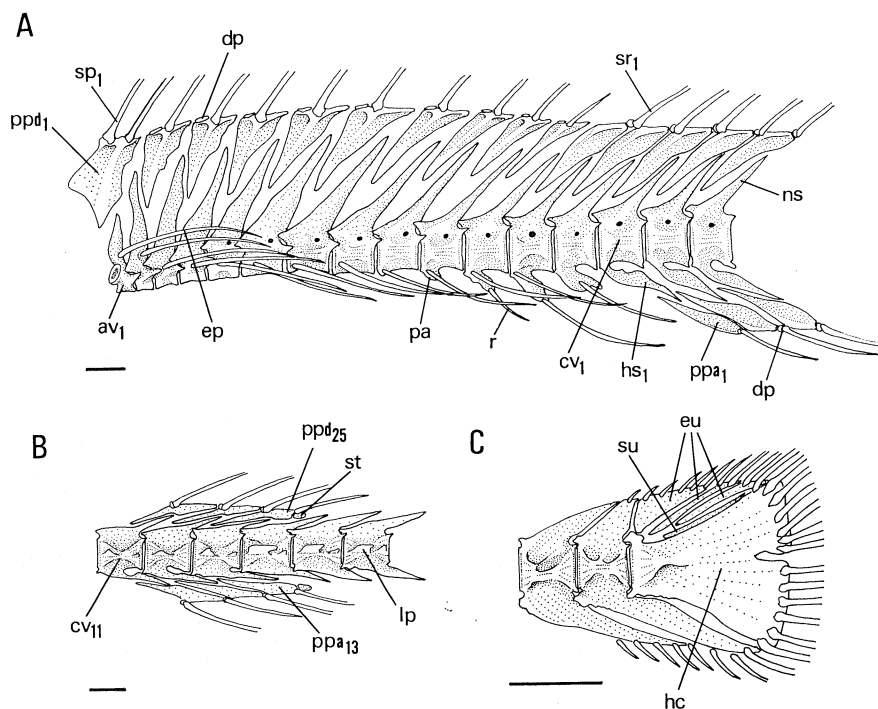


Fig. 5 Lateral aspects of vertebrae and associated bones in *Marukawichthys pacificus*, paratype (HUMZ 68660). A, anterior 16 vertebrae and their associated bones. B, 24th to 29th vertebrae and their associated bones. C, caudal skeleton. av, abdominal vertebrae; cv, caudal vertebrae; dp, distal pterygiophore; ep, epipleural; eu, epural; hc, hypural-parhypural complex bone; hs, haemal spine; lp, lateral process of caudal vertebrae; ns, neural spine; pa, parapophysis; ppa, proximal pterygiophore of anal series; ppd, proximal pterygiophore of dorsal series; r, rib; sp, dorsal spine; sr, dorsal soft ray; st, stay; su, stegural. Scale bars indicate 5 mm.

the palatine bears villiform teeth. The preopercle (po) bears five spines posteroventrally. The tubular structure is well developed on the posterior margin of the preopercle. The interopercle (in) is connected with the retroarticular anteriorly and to the subopercle (so) posteriorly by strong ligaments. This bone is ligamentously connected to the epihyal medially.

Hyoid and branchial arches (Fig. 4C, D, F): There is a small slit on the dorsolateral face of the ceratohyal (ch). Six branchiostegals (bs) are present; the anterior four attach to the ceratohyal, and the posterior two attach to the epihyal (eh). The basihyal is absent. The first basibranchial (bb) lies between dorsal pair of the hypohyals (hh). The fifth ceratobranchial (cb₅) bears villiform teeth dorsally. Four pairs of the epibranchials (eb) are present; the first one is articulated with the first pharyngobran-

chial and connected with the second pharyngobranchial by a strong ligament, while the posterior three are articulated with the third pharyngobranchial. Three pairs of pharyngobranchials are present; the first one is small and rod-like shaped and is connected with the prootic distally; the second and third are plate-like bones and bear villiform teeth on the oral surface.

Pectoral girdle (Fig. 4, E): The coracoid (cc) is separated from the scapula (sc) by the interposition of cartilage. The upper two actinosts (ac) and the scapula support the upper 11 pectoral rays. The lower two actinosts support the lower four free pectoral rays. There is a movable cartilage (mc) between the lower two actinosts and the free pectoral rays.

Pelvic girdle (Fig. 4, G): The pelvis (p) articulates with the ventromedial face of the

cleithrum anterolaterally. The postpelvic process (pp) and the subpelvic process (sp) are well developed. There is a small pore at the lateral angle of this bone where the pelvic spine is articulated.

Postcranial axial skeleton (Fig. 5): The first four vertebrae are shorter than the following ones. The first abdominal vertebra is modified to form three articulations with the cranium. The first neural arch is not fused to its opposite member and it lacks a neural spine. The following vertebrae have a complete neural arch and neural spine (ns). The parapophysis (pa) is developed on the 7th to 13th abdominal vertebrae; the first three are not fused to their opposite members, while the posterior four are fused to form the complete haemal arches. The 11th to 23rd caudal vertebrae have the lateral processes (lp). Epipleurals (ep) are present on the anterior 12 vertebrae. Ribs (r) present on the 11th to 13th abdominal vertebrae. The hypural and parhypural are fused to form a single complex bone (hc). A slender stegural (su) is present. Three epurals (eu) are present; the anteriormost one is triangular bone, while the posterior two are slender bones.

Median fin supports (Fig. 5): There are 25 proximal pterygiophores in the dorsal series (ppd) (anterior 10 supporting spiny rays, and posterior 15 supporting soft rays), and 13 ones in the anal series (ppa). The first proximal pterygiophore of the dorsal series inserts before the first vertebra. There is no pterygiophore in the interspace between the first and second vertebrae. All proximal pterygiophores support fin rays. A distal pterygiophore (dp) is present on all proximal pterygiophores except for the first and the last ones in the dorsal series and the last one in the anal series. There is a stay (st) just behind the last proximal pterygiophores in dorsal and anal series. The median pterygiophore is absent.

Remarks. Judging from the osteological features, the new species fits the definition of the family Ereuniidae (sensu Yabe, 1981) rather than Cottidae by having following osteological features: 1) four free rays of pectoral fin are present, 2) the basisphenoid is absent, 3) the basihyal is absent, 4) the pterospheonoid and parasphenoid are separated by interposition of the prootic, 5) three pharyngobranchials are

present, 6) the first pterygiophore of the dorsal series inserts before the first vertebra, 7) the hypural and the parhypural are fused to make a single fan shaped bone, 8) the stegural is present, 9) the stay is present behind last proximal pterygiophore of dorsal and anal series, 10) the lateral processes are well developed on the caudal vertebrae.

This family is composed of two genera *Marukawichthys* and *Ereunias*. Matsubara (1936) indicated the differences between these two genera based on the two species, *Marukawichthys ambulator* and *Ereunias grallator*. According to his comparison, the new species resembles *E. grallator* in the proportion of some body parts and coloration of body. But the new species conforms to the genus *Marukawichthys* by having following characters (condition in *Ereunias* is shown in parentheses); 1) pelvic fin is composed of one spine and four soft rays (only one vestigial spine under the skin or absent), 2) supralateral scale row is present (absent), 3) five preopercular spines are present (three preopercular spines), 4) a small spine is present on the posterodorsal face of the cleithrum (absent), 5) all proximal pterygiophores of dorsal series support fin rays (two proximal pterygiophores between first and second fins do not support fin rays).

The osteological condition in the present species is essentially the same as that in *M. ambulator* except for the number of vertebrae. The present species differs from *M. ambulator* in the following characters with the condition of the latter shown in parentheses; 1) narrow interorbital space, its width 19.6~21.2 in HL (9.0~16.0), 2) long upper jaw, its length 2.3~2.5 in HL (2.7~3.0), 3) broad maxillary end, its depth 2.2~2.5 times interorbital width (0.9~1.5), 4) narrow infraorbital, its width 3.3~3.8 in snout length (2.3~2.7), 5) gill rakers on the first arch 3+12~13=15~16 (2~3+7~10=10~12), 6) vertebrae 13+25~26=38~39 (13+22~24=35~37), 7) chin covered with smooth skin (rough skin) (Fig. 2), 8) body dark brown without cross bands (pale grayish brown diffused with dark cross bands). It is feared that the differences affected by the gap of body length between these two species are included in the above characters, because all specimens of *M. pacificus* (229.4~274.7 mm SL) are larger than

the comparative materials of *M. ambulator* (82.2~181.8 mm SL). But as far as comparison examined here, these characters are regarded as effective characters to discriminate these two species.

About fifty species are known from the ichthyofauna of the Emperor Seamount region, but cottoid fishes have not previously been recorded (Sasaki, 1973; Chen 1980). *M. pacificus* is the first discovery of a cottoid fish from this region.

Key to the genera and species of the family Ereuniidae

- A₁. Pelvic fin composed of one vestigial spine under the skin or absent. Five rows of spiny scales on body; the supralateral scale row absent. Preopercular spine three. No spine on posterodorsal face of the cleithrum Genus *Ereunias* Jordan et Snyder, *E. grallator* Jordan et Snyder (western North Pacific off south Japan)
- A₂. Pelvic fin rays I, 4. Six rows of spiny scales on body; supralateral scale row present. Preopercular spine five. A small spine present on the posterodorsal face of the cleithrum Genus *Marukawichthys* Sakamoto
- B₁. Chin covered with small ctenoid scales. Interorbital width 9.0~16.0 in HL. Length of upper jaw 2.7~3.0 in HL. Depth of maxillary end 0.9~1.5 times interorbital width. Infraorbital width 2.3~2.7 in snout length. Total gill rakers on 1st arch 10~12. Total vertebrae 35~37. Body with dark cross bands *M. ambulator* Sakamoto (western North Pacific off Japan; Toyama Bay in Japan Sea)
- B₂. Chin covered with smooth skin. Interorbital width 19.6~21.2 in HL. Length of upper jaw 2.3~2.5 in HL. Depth of maxillary end 2.2~2.5 times interorbital width. Infraorbital width 3.3~3.8 in snout length. Total gill rakers on 1st arch 15~16. Total vertebrae 38~39. Body uniformly dark without cross bands *M. pacificus* sp. nov.

(Emperor Seamount Chain in central North Pacific)

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(Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, Hakodate 041, Japan)

中部北太平洋から採集されたマルカワカジカ属の1新種

矢部 衛

中部北太平洋の天皇海山 (35°29.3'N, 171°42.0'E, 水深 570 m) から採集された新種テングカジカ *Marukawichthys pacificus* を記載した。本種は胸鰭の下部4軟条が上葉から遊離していること、腹鰭が1棘4軟条からなることからマルカワカジカ属に含まれる。しかし本種は本属の唯一の既知種マルカワカジカとは、下顎下面に鱗を持たないこと、脊椎骨数および鰓耙数が多いこと、両眼間隔幅が狭いこと、上顎が長いこと、眼下域が狭いこと、体色が一様に暗褐色を呈すること

などで明瞭に識別される。また本種の骨格系を観察した結果、副蝶形骨と翼蝶形骨が離れていること、咽鰓骨が3対あること、背鰭の第一担鰭骨が第一椎体より前方に位置すること、尾椎に発達した側方突起があることなどの特徴が認められた。これらの骨格系の諸特徴はマルカワカジカの状態と一致するとともに、Yabe (1981) により示されたトリカジカ科の骨格形態の特徴にも一致する。本種は天皇海山域から報告された初めてのカジカ上科魚類である。

(041 函館市港町 3-1-1 北海道大学水産学部水産動物学講座)